

REMARKS

In response to the Office Action dated May 4, 2005, claims 1-35 have been canceled without prejudice or disclaimer, new claims 36-46 have been added. No new matter has been added. Reexamination and reconsideration of the claims as requested is respectfully requested.

On page 2 of the Office Action, claims 25, 27, and 31-34 are rejected under 35 U.S.C. §102 (b) as being anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Shibuta (U.S. 5,853,877).

Applicant respectfully traverses this rejection.

To anticipate a claim, a reference must teach every element of the claim. "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). "The identical invention must be shown in as complete detail as is contained in the ... claim." *Richardson v. Suzuki Motor Co.*, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). Therefore, all claim elements, and their features, must be found in a cited reference to maintain a rejection based on 35 U.S.C. § 102.

Three criteria must be met to establish a prima facie case of obviousness. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference. Second, there must be a reasonable expectation of success. Finally, the prior art reference, or combination of references, must teach or suggest all the claim limitations. MPEP § 2142.

Shibuta teaches hollow carbon microfibers being treated with a particular solution comprising a strong acid containing sulfur in addition to an oxidizing agent. The microfibers are treated until they are easily disentangled in a polar solution. The endpoint in treating the microfibers is judged by measuring the disappearance of nitrous acid (the gaseous products of the reduction of nitric acid – Column 4, lines 30-34 and Column 5, lines 19-22).

On the contrary, an object of the present invention is a process for substantially oxidizing only the outer wall of a multiwall carbon nanotube and binding the multiwall carbon nanotube to a substrate. The substantial oxidation of only the outer wall has two effects. First, the oxidation of the outer wall leads to the outer wall losing its ability to conduct electric current while the conduction of electricity through the multiwall carbon nanotube is automatically taken over by the next inner nanotube. Second, the substantial oxidation of the outer wall leads to the multiwall carbon nanotube being bound covalently to the substrate when brought into contact with the substrate.

According to the present invention, by the substantial oxidation of the outer wall, i.e. the oxidation of a large number of carbon atoms present in the outer wall, chemically reactive groups are generated on the outer wall of the multiwall carbon nanotube (page 5, lines 31-34).

The functionalized multiwall carbon nanotube is brought into contact with a substrate so that covalent chemical bonds are formed between the substrate and the chemically reactive groups which have been generated on the outer wall of the multiwall nanotube. By the formation of covalent bonds between the nanotube and the substrate, the nanotube is bound in a slip-resistant manner to the substrate (page 3, lines 2-3).

A further object of the invention is to provide a multiwall carbon nanotube arrangement comprising a substrate and at least one multiwall carbon nanotube, wherein the at least one multiwall carbon nanotube comprises an outer wall and at least one inner wall, in which only the outer wall is substantially oxidized, so that this substantial oxidation leads to an electrically insulating effect, so that the outer wall of the multiwall carbon nanotube loses its ability to conduct electric current, and the inner wall or walls are not oxidized, so that the conduction of electricity through the multiwall carbon nanotube is automatically taken over by the next inner nanotube, and wherein, due to the substantial oxidation of the outer wall, the at least one multiwall carbon nanotube is bound covalently bound to the substrate.

This object of the invention is accomplished by substantially oxidizing only the outer wall of a multiwall carbon nanotube and bringing the multiwall carbon nanotube into contact with the substrate.

The document of Shibuta fails to teach or suggest a process for substantially oxidizing only the outer wall of a multiwall carbon nanotube and binding the multiwall carbon nanotube covalently (and thus in a slip-resistant manner) to a substrate. Shibuta also fails to teach or suggest a multiwall carbon nanotube arrangement, in which, due to the substantial oxidation of the outer wall of a multiwall carbon nanotube, this multiwall carbon nanotube is bound covalently to a substrate.

Shibuta discloses an electrically conductive transparent film comprising hollow carbon microfibers and a method of making such a film. This film is made by treating carbon microfibers with a strong acid containing sulfur and an oxidizing agent to form disentangled fibers and finally forming said film.

In contrast, the present invention provides a multiwall carbon nanotube arrangement comprising a substrate and at least one multiwall carbon nanotube, wherein the outer wall of the nanotube is substantially oxidized. Furthermore, the invention provides a process for substantially oxidizing only the outer wall of a multiwall carbon nanotube and binding the multiwall carbon nanotube to a substrate. The present invention is used for the construction of nanocircuits on a substrate, with multiwall carbon nanotubes being used in order to electrically contact the electronic components of such nanocircuits. In this context, the substantial oxidation of the outer walls of the multiwall carbon nanotubes on the one hand prevents electric short circuiting between crossing multiwall carbon nanotubes, and, on the other hand, prevents moving of the nanotubes by slipping on the substrate, since due to the substantial oxidation chemically reactive groups are formed on the outer walls and these chemically reactive groups form covalent bonds with the substrate.

Shibuta does neither teach a multiwall carbon nanotube arrangement with multiwall carbon nanotubes being covalently bound to a substrate nor does it suggest or even teach a process for binding a multiwall carbon nanotube to a substrate utilizing a substantial oxidation of the outer wall of that nanotube. Shibuta also fails to teach the use of multiwall carbon nanotubes in order to electrically contact electronic components of a nanocircuit.

Thus Shibuta neither anticipates nor renders obvious, new independent claim 36 or the new claims dependent therefrom.

Applicant respectfully requests the Examiner withdraw the rejection under U.S.C. §102 (b) as being anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Shibuta.

On page 3 of the Office Action, claim 29 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Shibuta. Additionally, claims 26, 28, 30 and 35 are rejected as being unpatentable over Shibuta as applied to claims 25, 27, and 31-34 and further in view of Stephan, et al. ("Doping Graphitic and Carbon Nanotube Structures with Boron and Nitrogen").

Applicant respectfully traverses these rejections.

Stephan, et al. discloses multiwalled carbon nanotubes having carbon atoms substitutionally replaced by boron and nitrogen atoms in various amounts. Neither Stephan, et al., when considered as a single document, nor Stephan, et al., in combination with Shibuta, teach or suggest a multiwall carbon nanotube arrangement, with the multiwall carbon nanotube being doped with boron nitride and only the outer wall being substantially oxidized and, due to the substantial oxidation of the nanotube's outer wall, the nanotube being bound covalently to a substrate as claimed in the present application.

Applicant respectfully requests the Examiner withdraw the rejections under 35 U.S.C. § 103(a) as being unpatentable over Shibuta as well as those over Shibuta and further in view of Stephan.

CONCLUSION

In view of the amendments and reasons provided above, it is believed that all pending claims are in condition for allowance. The amendments clarify the patentable invention without adding new subject matter. Applicant respectfully requests favorable reconsideration and early allowance of all pending claims.


If a telephone conference would be helpful in resolving any issues concerning this communication, please contact Applicant's attorney of record, Jeffrey R. Stone at 952 253-4130.

Respectfully submitted,

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